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A Machine Learning Approach to Driver Fatigue Detection via Facial Behavior and SVM

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ABSTRACT_ This project focuses on detecting driver drowsiness by analyzing the driver's visual behavior using a webcam and a machine learning model based on the Support Vector Machine (SVM) algorithm. The system utilizes the built-in webcam to continuously capture images of the driver, and with the help of OpenCV, it extracts key facial features such as eye and mouth positions.A pre-trained SVM model is employed to classify signs of drowsiness. The system monitors eye closure over a sequence of frames—specifically, detecting if the driver's eyes remain closed for 20 consecutive frames—or signs of yawning based on mouth movements. To achieve this, the application calculates the Euclidean distance between facial landmarks related to the eyes and mouth. If these distances align with drowsiness indicators, the system triggers an alert message to warn the driver.This real-time monitoring approach is designed to reduce the risk of accidents caused by driver fatigue, offering a practical and efficient solution for enhancing road safety.

1.INTRODUCTION

One of the main contributors to fatalities in road accidents is drowsy driving. Truck drivers working continuous long hours, particularly at night, bus drivers of long distance routes or overnight buses are more vulnerable to this issue. For passengers in every nation, driver sleepiness is a gloomy nightmare. Fatigue connected road accidents cause many injuries and fatalities every year. Therefore, active study is the detection of driver's weariness and its indication since it has great practical relevance.

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There are three blocks/modules in the fundamental drowsiness detection system: acquisition system, processing system, and warning system. The driver's frontal face video is taken in acquisition system and sent to the processing block where it is evaluated online to identify tiredness. Should drowsiness be found, the warning system sends the driver a warning or alert. The sensors are not connected on the driver, hence this is a nonintrusive measurement. Behavioural based technique [1- 7] detects tiredness by means of visual behaviour of the driver i.e., eye blinking, eye closing, yawn, head bending etc. Using a basic camera to identify these characteristics makes this also non-intrusive measurement. Physiological based techniques [8,9] examine physiological signals such as Electro cardiogram (ECG), Electo oculogyric (EOG), Electro encephalogram (EEG), heartbeat, pulse rate, etc. and from these measurements, drowsiness or exhaustion level is identified. This is intrusive measurement since the sensors are attached to the driver, which will distract him or her. System cost as well as size will rise depending on the sensors employed in the system. But, adding more parameters/features will improve the system's accuracy to some degree. These elements inspire us to create a low-cost, real time driver's sleepiness detection system with reasonable accuracy. Therefore, we have suggested a webcam based system to identify driver's fatigue from the face image solely utilising image processing and machine learning techniques to make the system low-cost as well as portable.

2.LITERATURE SURVEY

W. L. Ou et al., "Intelligent Video-Based Drowsy Driver Detection System under Various Illuminations and Embedded Software Implementation," Two thousand fifteen

Designed to work well under different lighting situations, this paper offers a video-based driver sleepiness detection system. Focussing on face traits suggestive of tiredness, the system uses image processing methods to track driver behaviour. Real-time processing is guaranteed by an embedded software implementation, so the system is appropriate for inclusion inside cars to improve road safety.

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W. B. Horng et al., "Driver Fatigue Detection based on Eye Tracking and Dynamic Template Matching," 2004

Using eye tracking and dynamic template matching, the authors suggest a real-time driver fatigue detection system. The technology may identify indicators of exhaustion, such as prolonged eye closure, by constantly tracking eye movements and comparing them to dynamic templates, therefore delivering timely alerts to avert mishaps.

Study Gate

S. Singh and N. P. Papanikolopoulos, "Monitoring Driver Fatigue using Facial Analysis Techniques"

This study emphasises facial analysis as a means of tracking driver weariness. The device may detect indications of tiredness by means of facial expression and movement analysis. The paper underlines the need of non-intrusive monitoring techniques to guarantee driver comfort while preserving safety.

"Driver Drowsiness Detection System," 2013

The research presents a driver sleepiness detection system using image processing methods to track facial characteristics. The device can identify drowsiness and send alarms by means of eye closure and head movement analysis, so hoping to lower road accidents brought on by driver weariness.

M. Karchani et al., "The Steps of Proposed Drowsiness Detection System Design based on Image Processing in Simulator Driving," two thousand fifteen

This paper presents the creation of a sleepiness detection system based on image processing inside a driving simulator. The technology evaluates driver attention by means of eye and facial movement tracking. The study underlines how well image-based methods detect tiredness early, hence helping to prevent accidents.

University

R. Ahmad and J. N. Borole, "Drowsy Driver Identification Using Eye Blink Detection," 2015

By means of eye blink detection, the authors offer a technique to spot tired drivers. The device tracks blink patterns using a webcam and image processing techniques to find extended closures suggestive of tiredness. The

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method provides a non-intrusive answer for real-time driver monitoring.

Non-intrusive Drowsiness Detection by Using Support Vector Machine, A. Abas et al. two thousand fourteen

This work presents a non-intrusive sleepiness detection approach based on Support Vector Machine (SVM) classifiers. The technology can categorise driver attentiveness levels by means of feature analysis like steering wheel angle and lane position. The method stresses excellent detection accuracy with little intervention.

A. Sengupta et al., "A Multimodal System for Assessing Alertness Levels Due to Cognitive Loading," 2017

By means of a multimodal system, the study suggests evaluating driver attentiveness by means of cognitive load analysis. The technology offers a thorough assessment of driver awareness by combining data from EEG, facial expressions, and speech patterns. The study shows how well several modalities work together for precise detection.

Study Gate

[9] K. T. Chui et al., "An Accurate ECG-Based Transportation Safety Drowsiness Detection Scheme," 2016

This work offers a drowsiness detection system using electrocardiogram (ECG) signals. The device can precisely identify drowsiness by means of machine learning techniques and analysis of heart rate variability. The study emphasises how physiological cues could improve transportation safety.

N. Dalal and B. Triggs, "Histograms of Orientated Gradients for Human Detection," 2005

The authors present the object recognition feature descriptor known as Histograms of Orientated Gradients (HOG). HOG offers great performance in human detection jobs by use of edge and gradient structure capture. Including driver monitoring systems, the method has become basic in computer vision applications.

V. Kazemi and J. Sullivan, "One Millisecond Face Alignment with an Ensemble of Regression Trees," two thousand fourteen

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Using an ensemble of regression trees, this work offers a quick face alignment technique. The method allows for real-time identification of facial landmarks, hence enabling uses including driver drowsiness detection when speed and accuracy are essential..

3.PROPOSED SYSTEM

Using machine learning SVM (support vector machine), this research tracks visual behaviour with camera to identify drowsiness in a driver. This app will read photos of a driver using inbuilt webcam and then, using OPENCV SVM algorithm, extract facial features from the image and check whether driver in picture is blinking his eyes for consecutive 20 frames or yawning mouth then application will alert driver with Drowsiness messages.

3.1 MODULES

3.1 Video Recording: Using this module we will connect application to webcam using OPENCV built-in function called Video Capture.

3.2 Frame Extraction: Using this module we will grab frames from webcam and then extract each picture frame by frame and convert image into 2 dimensional array.

3.3 Face Detection & Facial Landmark Detection: Using SVM algorithm we will detect faces from images and then extract facial expression from the frames.

3.4 Detection: Using this module we will detect eyes and mouth from the face

3.5 Calculate: Using this module we will calculate distance with Euclidean Distance formula to check whether given face distance closer to eye blinks or yawning, if eyes blink for 20 frames continuously and mouth open as yawn then it will alert driver.

3.6 Face Detection Using OpenCV

This seems complex at first but it is very easy. Let me walk you through the entire process and you will feel the same.

Step 1: Considering our prerequisites, we will require an image, to begin with. Later we need to create a cascade classifier which will eventually give us the features of the face.

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Step 2: This step involves making use of OpenCV which will read the image and the features file. So at this point, there are NumPy arrays at the primary data points.

All we need to do is to search for the row and column values of the face NumPy N dimensional array. This is the array with the face rectangle coordinates.

Step 3: This final step involves displaying the image with the rectangular face box.

4. ALGORITHM DESCRIPTION

Machine learning is the prediction and classification of data; to do this we apply various machine learning algorithms based on the dataset. For regression and classification problems, a linear model is SVM or Support Vector Machine. It can manage linear and non-linear problems and perform effectively for many real challenges. The idea of SVM is simple: The algorithm creates a hyperplane or line separating the data into groups. A well-known kernel function in machine learning used in several kernelized learning methods is the radial basis function kernel, or RBF kernel. Support vector machine classification makes particularly frequent use of it. A hyperplane may be viewed as a line that linearly separates and classifies a set of data for a classification task with only two traits (like the image above).

Intuitively, the more positive we are that our data points have been correctly classified the further from the hyperplane they live. Therefore, our data points should be as far from the hyperplane as feasible yet still on the correct side of it. The class we assign to new test data added will therefore be decided by whatever side of the hyperplane it falls.

How can we find the right hyperplane? Or, in other words, how can we best distinguish the two groups within the data?

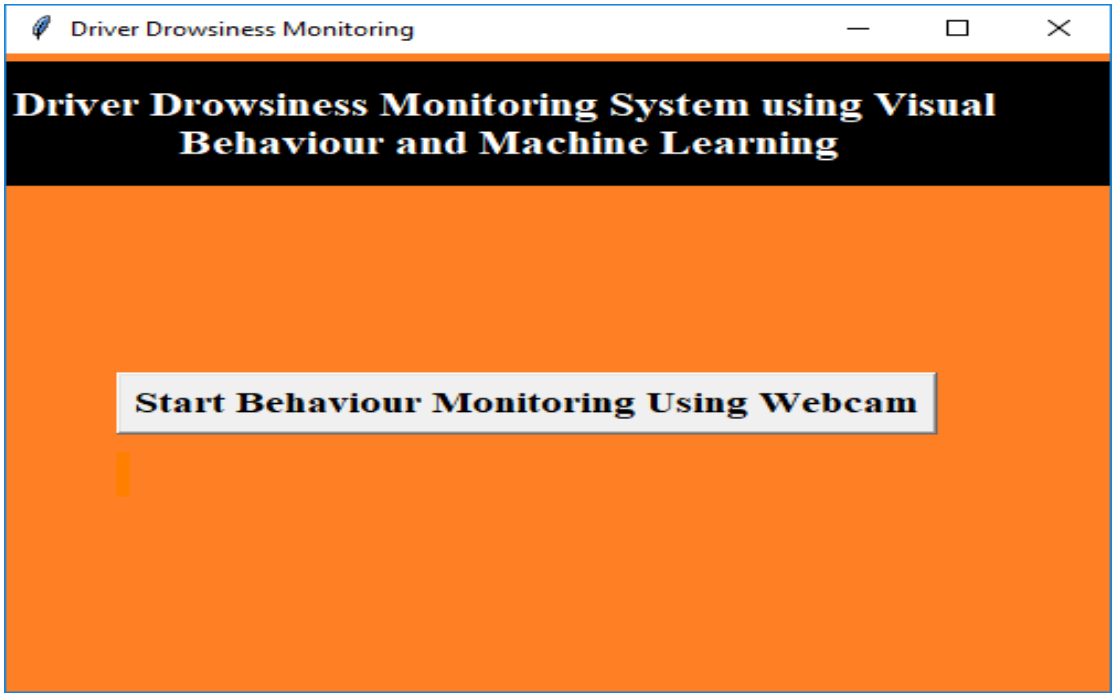
The margin is the distance between the hyperplane and the nearest data point from either collection. The goal is to choose a hyperplane with the biggest practicable margin between the hyperplane and any point inside the training set, hence boosting the probability of correct classification of new data.

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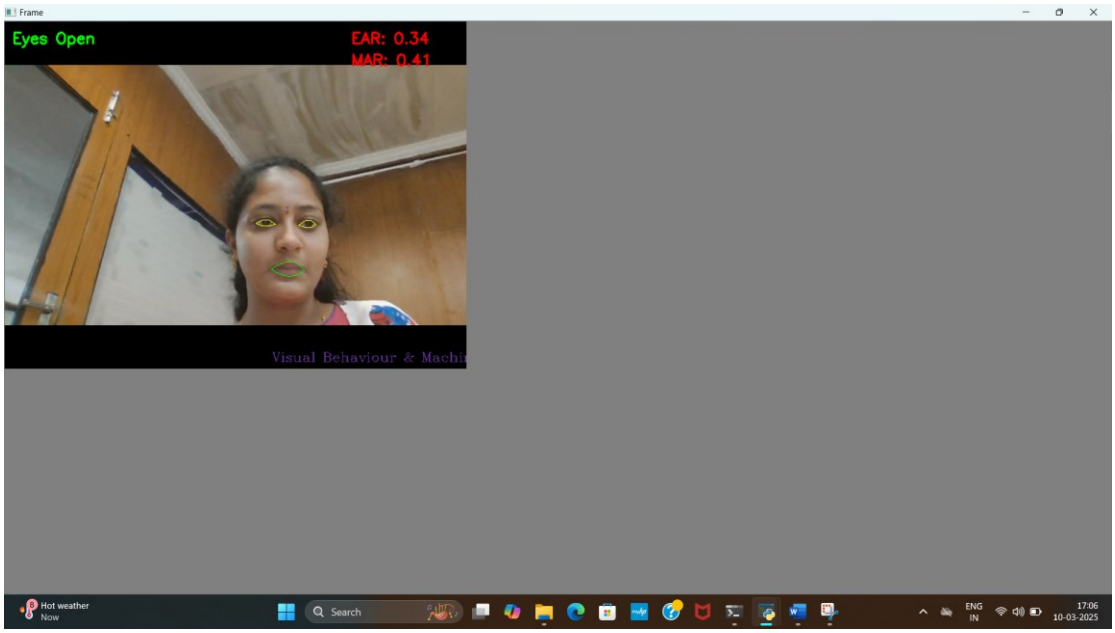
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5.RESULTS AND DISCUSSIONS



5.1 In above screen click on 'Start Behaviour Monitoring Using Webcam' button to connect application with webcam, after clicking button will get below screen with webcam streaming

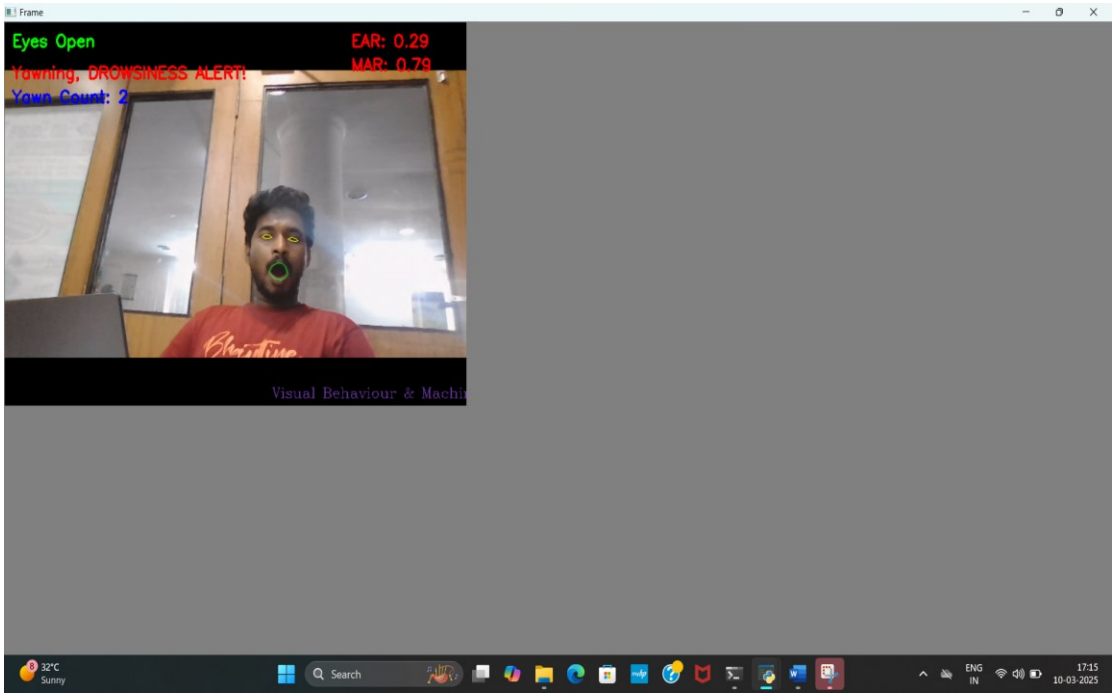


5.2 In above screen we can see web cam stream then application monitor all frames to see person eyes are open or not, if closed then will get below message

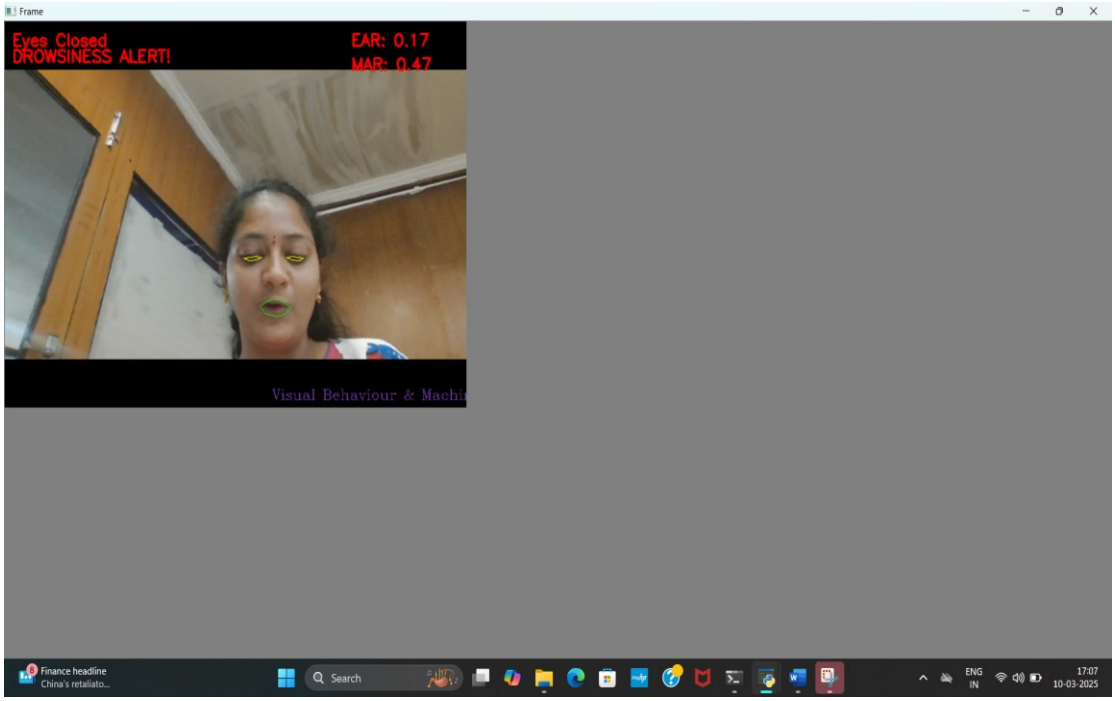
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5.3 Similarly if mouth starts yawn then also will get alert message



5.4 Above application monitor all frames to see person eyes are open or not, if closed then will get below message

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6.CONCLUSION

Currently, artificial intelligence and visual conduct have suggested minimal effort, ongoing driver tiredness observing system. Here, visual behaviour highlights like eye viewpoint proportion, mouth opening proportion and nose length proportion are computed from the leaking video, acquired by a webcam. A flexible thresholding technique has been developed to continually detect driver languor. The developed system functions exactly with the generated designed data. Thus, the component values are stored and AI algorithms have been used for order. Examined here are Bayesian classifier, FLDA and SVM. FLDA and SVM have been shown to outperform Bayesian classifier.

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